

A SWITCHING MECHANISM OF A LENS BARREL FOR SWITCHING
BETWEEN AUTOMATIC AND MANUAL FOCUSING MODES

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a lens barrel which can be used as a photographing lens of an AF camera, and more specifically, to a switching mechanism of such a lens barrel for switching between automatic focusing and 10 manual focusing.

2. Description of the Related Art

Figures 8 through 11 show a conventional interchangeable lens barrel having a switching mechanism between an automatic focusing mode and a manual focusing 15 mode. The lens barrel 01 includes a stationary barrel 03 having a small-diameter ring portion 07 and a large-diameter ring portion 05 positioned radially outside the small-diameter ring portion 07. A distance adjustment ring 09 is positioned between the small-20 diameter ring portion 07 and the large-diameter ring portion 05 to be freely rotatable about an optical axis 0. An AF/MF switching ring 011 for switching between an automatic focusing mode and a manual focusing mode is fitted on the large-diameter ring portion 05. The AF/MF 25 switching ring 011 is freely rotatable about the optical

axis O and movable along the optical axis O relative to the large-diameter ring portion 05 between an AF position and an MF position to switch between an automatic focusing mode and a manual focusing mode, respectively. A lens holding ring 013 for holding a focusing lens group L is screw-engaged with the small-diameter ring portion 07. A rotation of the distance adjustment ring 09 causes the lens holding ring 013 to move along the optical axis O while rotating about the optical axis O. The lens barrel 01 is provided between the large-diameter ring portion 05 and the small-diameter ring portion 07 with an AF drive mechanism 015 which transfers a rotation of an AF motor (provided in a camera body (not shown) to which the lens barrel 01 is mounted) to the distance adjustment ring 09 to perform an autofocusing operation when the AF/MF switching ring 011 is in the AF position (automatic focusing mode). When the AF/MF switching ring 011 is in the MF position (manual focusing mode), the AF drive mechanism 015 is disengaged from the distance adjustment ring 09.

The large-diameter ring portion 05 is provided, on an outer peripheral surface thereof at the front end of the large-diameter ring portion 05, with a plurality of stop grooves 017 which extend in a direction of the optical axis O (i.e., optical axis direction). The plurality of

stop grooves 017 are arranged in a circumferential direction of the large-diameter ring portion 05. An AF engaging member 019 is fixed to an inner peripheral surface of the AF/MF switching ring 011. The AF engaging member 019 is engaged with one of the plurality of stop grooves 017 to prevent the AF/MF switching ring 011 from rotating when the AF/MF switching ring 011 is in the AF position (see Figures 8 and 10). The distance adjustment ring 09 is provided at the front end thereof with a plurality of engaging grooves 021 which extend in the optical axis direction (see Figure 11). The plurality of engaging grooves 021 are arranged in a circumferential direction of the distance adjustment ring 09. The AF/MF switching ring 011 is provided at the front end thereof with an inner flange 023. An MF engaging pin 025 projects rearwards from a rear surface of the inner flange 023 to be engaged with any one of the plurality of engaging grooves 021. The MF engaging pin 025 is engaged in one of the plurality of engaging grooves 021 when the AF/MF switching ring 011 is in the MF position to transmit rotation of the AF/MF switching ring 011 to the distance adjustment ring 09.

In the lens barrel 01 having the above described structure, the MF engaging pin 025 is disengaged from the plurality of engaging grooves 021 when the AF/MF switching

ring 011 is in the AF position to allow the AF drive mechanism 015 to perform an auto-focusing operation. When the AF/MF switching ring 011 is in the MF position, the MF engaging pin 025 is engaged in one of the plurality 5 of engaging grooves 021 so that a rotation of the AF/MF switching ring 011 is transferred to the distance adjustment ring 09 to perform a focusing operation (manual focusing operation) when the AF/MF switching ring 011 is manually rotated.

10 Installation of both the AF engaging member 019 and the MF engaging pin 025 at different positions on the AF/MF switching ring 011 increases the cost of production, the cost of assembly and the size of the lens barrel 01.

15 SUMMARY OF THE INVENTION

The present invention provides a lens barrel having a switching mechanism between an automatic focusing mode and a manual focusing mode, wherein the cost of production and the cost of assembly of the lens barrel can be reduced 20 while further miniaturizing the lens barrel.

According to an aspect of the present invention, a switching mechanism of a lens barrel for switching between an automatic focusing mode and a manual focusing mode, the switching mechanism including a stationary barrel 25 having at least one stop groove; a lens holding ring,

positioned concentrically with the stationary barrel,
the lens holding ring holding at least one lens group;
a distance adjustment ring which is positioned
concentrically with the stationary barrel, immovable
5 along an optical axis relative to the stationary barrel,
and rotatable about the optical axis relative to the
stationary barrel, wherein a rotation of the distance
adjustment ring causes the lens holding ring to move along
the optical axis, and wherein the distance adjustment ring
10 includes at least one engaging groove; and an AF/MF
switching ring which is positioned concentrically with
the stationary barrel, movable along the optical axis
relative to the stationary barrel, and rotatable about
the optical axis relative to the stationary barrel,
15 wherein movement of the AF/MF switching ring relative to
the stationary barrel between an AF position and an MF
position switches between the automatic focusing mode and
the manual focusing mode, respectively, and wherein the
AF/MF switching ring includes an engaging member which
20 is selectively engaged with the stop groove and the
engaging groove. The AF/MF switching ring is prevented
from rotating relative to the stationary barrel by
engagement of the engaging member with the stop groove
while a driving force is transferred from a power source
25 to the distance adjustment ring to move the lens holding

ring along the optical axis when the AF/MF switching ring is in the AF position. A rotation of the AF/MF switching ring is transferred to the distance adjustment ring to move the lens holding ring along the optical axis via engagement of the engaging member with the engaging groove while the driving force is prevented from being transferred from the power source to the distance adjustment ring when the AF/MF switching ring is in the MF position.

It is desirable for the engaging member to include a first engaging portion and a second engaging portion which are fixed at opposite ends of a leaf spring in the optical axis direction to be engageable with the stop groove and the engaging groove, respectively, the leaf spring being elongated in the optical axis direction and a central portion thereof being fixed to said AF/MF switching ring. The leaf spring is resiliently deformed to move the first engaging portion to a non-engaging position thereof, wherein the first engaging portion is disengaged from the stop groove, when the AF/MF switching ring moves from the MF position to the AF position in the case where the first engaging portion is not aligned with the stop groove in the circumferential direction thereof. The leaf spring is resiliently deformed to move the second engaging portion to a non-engaging position thereof

wherein the second engaging portion is disengaged from the engaging groove when the AF/MF switching ring moves from the AF position to the MF position in the case where the second engaging portion is not aligned with the 5 engaging groove in the circumferential direction.

In another embodiment, a switching mechanism of a lens barrel for switching between an automatic focusing mode and a manual focusing mode is provided, the switching mechanism including a stationary barrel having at least one stop groove; a lens holding ring holding at least one lens group which functions as a focusing lens, the lens holding ring being movable in an optical axis direction; a distance adjustment ring being relatively rotatable with respect to the stationary barrel so that a rotation 10 of the distance adjustment ring causes the lens holding ring to move along the optical axis, the distance adjustment ring being provided with at least one engaging groove; an AF/MF switching ring being movable between an AF position and an MF position along the optical axis and 15 rotatable relative to the stationary barrel; an AF driving power mechanism which rotates the distance adjustment ring when the AF/MF switching ring is positioned at the AF position in accordance with object distance information; and a first engaging portion and a second 20 engaging portion which are fixed at opposite ends of a 25

leaf spring in the optical axis direction to be engageable with the stop groove and the engaging groove, respectively, the leaf spring being elongated in the optical axis direction and a central portion thereof being fixed to 5 the AF/MF switching ring. The leaf spring is resiliently deformed to move the first engaging portion to a non-engaging position thereof, wherein the first engaging portion is disengaged from the stop groove, when the AF/MF switching ring moves from the MF position to the AF 10 position in the case where the first engaging portion is not aligned with the stop groove in the circumferential direction thereof. The leaf spring is resiliently deformed to move the second engaging portion to a non-engaging position thereof wherein the second 15 engaging portion is disengaged from the engaging groove when the AF/MF switching ring moves from the AF position to the MF position in the case where the second engaging portion is not aligned with the engaging groove in the circumferential direction.

20 It is desirable for the stop groove of the stationary barrel to include a plurality of stop grooves arranged in a circumferential direction of the stationary barrel.

It is desirable for the engaging groove of the distance adjustment ring to include a plurality of stop 25 grooves arranged in a circumferential direction of the

stationary barrel.

It is desirable for the plurality of stop grooves to be arranged at equi-angular intervals.

It is desirable for the plurality of engaging 5 grooves to be arranged at equi-angular intervals.

It is desirable for the AF/MF switching ring to be fitted on the stationary barrel to be manually moved between the AF position and the MF position, and for the AF/MF switching ring to include a recess on an inner 10 peripheral surface thereof, the engaging member being positioned in the recess.

It is desirable for the leaf spring to be resiliently deformed so that the first engaging portion moves radially outwards when the AF/MF switching ring moves from the MF 15 position to the AF position in the case where the first engaging portion is not aligned with the stop groove in the circumferential direction, and for the leaf spring to be resiliently deformed so that the second engaging portion moves radially outwards when the AF/MF switching 20 ring moves from the AF position to the MF position if the second engaging portion is not aligned with the engaging groove in the circumferential direction.

In another embodiment, a switching mechanism of a lens barrel for switching between an automatic focusing 25 mode and a manual focusing mode is provided, the switching

mechanism including a stationary ring having a first plurality of engaging grooves arranged at equi-angular intervals about an optical axis; an AF/MF switching ring fitted on the stationary ring to be manually movable along

5 the optical axis relative to the stationary ring between an AF position and an MF position to switch between the automatic focusing mode and the manual focusing mode, respectively; a rotatable ring fitted in the stationary ring to be rotatable about the optical axis without moving

10 along the optical axis relative to the stationary ring, the rotatable ring having a second plurality of engaging grooves arranged at equi-angular intervals about an optical axis; and an engaging member fixed to opposite ends of a leaf spring in the optical axis direction, the

15 leaf spring fixed to the AF/MF switching ring, wherein the engaging member includes a first engaging portion and a second engaging portion of the engaging member are engageable in any one of the first plurality of engaging grooves and any one of the second plurality of engaging

20 grooves, respectively. The first engaging portion of the engaging member is engaged in one of the first plurality of engaging grooves when the AF/MF switching ring moves from the MF position to the AF position in the case where the first engaging portion is aligned with the one first

25 engaging groove in the circumferential direction thereof.

The second engaging portion of the engaging member is engaged in one of the second plurality of engaging grooves when the AF/MF switching ring moves from the AF position to the MF position in the case where the second engaging portion is aligned with the one second engaging groove in the circumferential direction thereof. The leaf spring is resiliently deformed so that the first engaging portion moves radially outwards when the AF/MF switching ring moves from the MF position to the AF position in the case where the first engaging portion is not aligned with the one first engaging groove in the circumferential direction, and so that the second engaging portion moves radially outwards when the AF/MF switching ring moves from the AF position to the MF position in the case where the second engaging portion is not aligned with the one second engaging groove in the circumferential direction thereof.

It is desirable for the rotatable ring to be driven to rotate by an AF motor provided in a camera body to which the lens barrel is mounted when the AF/MF switching ring is in the AF position, and a focusing lens group to move along the optical axis by a rotation of the AF/MF switching ring via the rotatable ring when the AF/MF switching ring is in the MF position.

25 The present disclosure relates to subject matter

contained in Japanese Patent Applications No.2002-302679 (filed on October 17, 2002) which is expressly incorporated herein by reference in its entirety.

5

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described below in detail with reference to the accompanying drawings in which:

Figure 1 is a longitudinal cross sectional view of
10 an embodiment of a lens barrel according to the present invention, showing an upper half of the lens barrel from the optical axis when an AF/MF switching ring is in the MF position;

Figure 2 is a view similar to that of Figure 1 and
15 shows the lens barrel in a state immediately after the AF/MF switching ring is moved from the MF position to the AF position;

Figure 3 is a view similar to that of Figure 2 and shows the lens barrel in a state when the AF/MF switching
20 ring is in the AF position, in which an AF engaging member is engaged in one of a plurality of stop grooves;

Figure 4 is a transverse cross sectional view, seen from the front thereof, of the lens barrel in a state shown in Figure 3, with certain parts omitted;

25 Figure 5 is a plan view of a fundamental portion of

the AF/MF switching ring;

Figure 6 is a plan view of a click stop mechanism with a stop ball;

Figure 7 is a transverse cross sectional view of the
5 click stop mechanism shown in Figure 6;

Figure 8 is a cross sectional view of a conventional lens barrel, showing an upper half of the lens barrel from the optical axis when an AF/MF switching ring is in the AF position;

10 Figure 9 is a view similar to that of Figure 8 and shows the conventional lens barrel when the AF/MF switching ring is in the MF position;

Figure 10 is a cross sectional view taken along X-X line shown in Figure 8; and

15 Figure 11 is a cross sectional view taken along XI-XI line shown in Figure 9.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Firstly, the overall structure of an embodiment of
20 a lens barrel shown in Figures 1 through 7 will be discussed hereinafter. The lens barrel 1 is an interchangeable lens which is mounted to a camera body of an AF (autofocus) camera system, e.g., an SLR AF camera system. The lens barrel 1 is provided with a stationary
25 barrel 3. The stationary barrel 3 is provided at the rear

end thereof with a bayonet mount ring 3a which can be mounted to a corresponding bayonet mount ring on a camera body. The stationary barrel 3 is provided with a large-diameter ring portion 5 and a small-diameter ring portion 7 which are concentrically arranged about an optical axis O. The small-diameter ring portion 7 is provided, on an outer peripheral surface thereof in close vicinity of the front end of the small-diameter ring portion 7, with a male thread portion 7a. The lens barrel 1 is provided between the large-diameter ring portion 5 and the small-diameter ring portion 7 with a focusing ring (lens holding ring) 9. The focusing ring 9 is provided on an inner peripheral surface thereof with a female thread portion 9a which is engaged with the male thread portion 7a of the small-diameter ring portion 7. The focusing ring 9 holds a focusing lens group L, and moves along the optical axis O due to engagement of the male thread portion 7a with the female thread portion 9a when the focusing ring 9 is rotated about the optical axis O.

The lens barrel 1 is provided inside the large-diameter ring portion 5 with a distance adjustment ring 11. The distance adjustment ring 11 is provided at a rear end thereof with a circumferential annular groove 11a. The large-diameter ring portion 5 is provided on an inner peripheral surface thereof with a circumferential

annular projection 5a which projects radially inwards to be engaged in the circumferential annular groove 11a of the distance adjustment ring 11. The distance adjustment ring 11 is freely rotatable about the optical axis O without moving along the optical axis O with respect to the large-diameter ring portion 5 due to engagement of the circumferential annular projection 5a with the circumferential annular groove 11a.

The distance adjustment ring 11 is provided on an inner peripheral surface thereof with a set of axial grooves 11b (only one of them appears in Figures 1 through 3) which extend parallel to the optical axis O. The focusing ring 9 is provided, on an outer peripheral surface thereof in the vicinity of the rear end of the focusing ring 9, with a corresponding set of drive power transfer pins 9b (only one of them appears in Figures 1 through 3) which project radially outwards to be engaged in the set of axial grooves 11b, respectively.

The small-diameter ring portion 7 is provided on an outer peripheral surface thereof with a circumferential annular flange 7b. The lens barrel 1 is provided between the large-diameter ring portion 5 and the small-diameter ring portion 7 with a rotary shaft 13 which extends parallel to the optical axis O. Opposite ends of the rotary shaft 13 are respectively supported by the

circumferential annular flange 7b and a rear wall 3b of the stationary barrel 3 to be freely rotatable on the axis of the rotary shaft 13. The rear end of the rotary shaft 13 is coupled to a front end of a rotary output shaft of 5 an AF motor M (Figure 3) provided in the camera body to which the lens barrel 1 is mounted so that the rotary shaft 13 is driven by the AF motor.

A gear cylinder(pinion gear) 15 is fitted on the rotary shaft 13 to be fixed thereto. More specifically, 10 the rotary shaft 13 is provided on an outer peripheral surface thereof with an axial groove 13a which extends linearly in a direction parallel to the optical axis O while the gear cylinder 15 is provided on an inner peripheral surface thereof with an engaging projection 15a which is slidably engaged in the axial groove 13a of the rotary shaft 13 so that the gear cylinder 15 rotates together with the rotary shaft 13 while being allowed to move linearly in the axial direction of the rotary shaft 13 (i.e., the optical axis direction) within a range of 15 the axial groove 13a with respect to the rotary shaft 13. A gear portion 15b which is formed on an outer peripheral surface of the gear cylinder 15 is engageable with a circumferential gear portion 11c which is formed on an inner peripheral surface of the distance adjustment ring 20 25 11 at the rear end thereof. The gear cylinder 15 is

provided behind the gear portion 15b with a flange 15c. A compression coil spring S is fitted on the rotary shaft 13 to be positioned between the flange 15c of the gear cylinder 15 and the rear wall 3b of the stationary barrel 5 in a compressed fashion to bias the gear cylinder 15 continuously forward. The AF motor M, the rotary shaft 13, the gear cylinder 15, the gear portion 15b and the circumferential gear portion 11c of the distance adjustment ring 11 constitute an AF driving power mechanism. This AF driving power mechanism rotates the distance ring 11 in accordance with object distance information stored in a memory (not shown).

The lens barrel 1 is provided around the large-diameter ring portion 5 with a hand-operated AF/MF 15 switching ring 17. The AF/MF switching ring 17 is fitted on the large-diameter ring portion 5 to be freely rotatable about the optical axis O, and movable along the optical axis O with respect to the large-diameter ring portion 5. The AF/MF switching ring 17 is provided on 20 an inner peripheral surface thereof with a front circumferential annular groove (MF-position holding groove) 17a and a rear circumferential annular groove (AF-position holding groove) 17b which is positioned behind the front circumferential annular groove 17a in 25 the optical axis direction.

As clearly shown in Figures 6 and 7, the large-diameter ring portion 5 is provided with a leaf-spring insertion slot 19 which extends in a circumferential direction of the large-diameter ring portion 5. The 5 leaf-spring insertion slot 19 is formed as a through slot at a position on the large-diameter ring portion 5 to face an inner peripheral surface of the AF/MF switching ring 17. The leaf-spring insertion slot 19 includes a spring-deformation allowing portion 21 which radially 10 extends through the large-diameter ring portion 5 to be elongated in a circumferential direction of the large-diameter ring portion 5, and a pair of stepped portions 23 which are positioned at opposite ends of the spring-deformation allowing portion 21 in the 15 circumferential direction of the large-diameter ring portion 5. A pair of opposed recesses 25 are formed on opposed surfaces of the large-diameter ring portion 5 in the spring-deformation allowing portion 21 at the center thereof in a direction of elongation of the spring-deformation allowing portion 21 . (the horizontal 20 direction as viewed in Figures 6 and 7) to receive a stop ball B in between the pair of opposed recesses 25. Accordingly, the amount of depression of each recess 25 is determined in association with the diameter of the stop 25 ball B.

A leaf spring 27 is inserted (simply dropped) into the leaf-spring insertion slot 19 and positioned therein so that the opposite ends of the leaf spring 27 lie on the pair of stepped portions 23, respectively. A central 5 portion of the leaf spring 27 is positioned in the spring-deformation allowing portion 21 to support the stop ball B fitted in between the pair of opposed recesses 25. The width of the leaf spring 27, which substantially corresponds to the width of the leaf-spring insertion slot 10 19, is smaller than the diameter of the stop ball B. The front circumferential annular groove 17a, the rear circumferential annular groove 17b, the leaf-spring insertion slot 19, the leaf spring 27 and the stop ball B are fundamental elements of a click stop mechanism for 15 determining an MF position (Figure 1) and an AF position (Figure 3) of the AF/MF switching ring 17.

As shown in Figures 1 through 3 and 7, the leaf spring 27 is resiliently deformed radially inwards, toward the optical axis O. The resiliency of the leaf spring 27 when 20 it is deformed as shown in Figures 1 through 3 and 7 biases the stop ball B radially outwards, in a direction away from the optical axis O, to be selectively engaged in the front circumferential annular groove 17a and the rear circumferential annular groove 17b. The AF/MF switching 25 ring 17 is held in the AF position (the position of the

AF/MF switching ring 17 shown in Figure 3) when the stop ball B is engaged in the rear circumferential annular groove 17b, and the AF/MF switching ring 17 is held in the MF position (the position of the AF/MF switching ring 5 17 shown in Figure 1) when the stop ball B is engaged in the front circumferential annular groove 17a.

The AF/MF switching ring 17 is provided, on an inner peripheral surface thereof in the vicinity of the rear end of the AF/MF switching ring 17, with an engaging recess 10 17c. The lens barrel 1 is provided therein with a coupling member 29 which extends radially between the gear cylinder 15 and the AF/MF switching ring 17. A radially outer end of the coupling member 29 is engaged in the engaging recess 17c of the AF/MF switching ring 17 so that 15 the coupling member 29 moves together with the AF/MF switching ring 17 in the optical axis direction. The coupling member 29 is provided with a slidable leaf 29a which extends in the optical axis direction. An axial guide groove 5b is formed on an outer peripheral surface 20 of the large-diameter ring portion 5 in the vicinity of the rear end thereof and is elongated in the optical axis direction, and the slidable leaf 29a is engaged in the axial guide groove 5b to be slidable on the large-diameter ring portion 5 in the axial guide groove 5b thereof. The 25 large-diameter ring portion 5 is provided in the axial

guide groove 5b with a radially through slot 5c. The coupling member 29 extends through the large-diameter ring portion 5 through the radially through slot 5c so that an engaging portion 29b formed at a radially inner 5 end of the coupling member 29 is engaged with the gear cylinder 15 between the gear portion 15b and the flange 15c. The flange 15c prevents the engaging portion 29b from being disengaged from the gear cylinder 15 by the engagement of the flange 15c with the engaging portion 10 29b.

The large-diameter ring portion 5 is provided at a front end thereof with a rear outer flange 31. The large-diameter ring portion 5 is provided, on an outer peripheral surface of the rear outer flange 31 that faces 15 an inner peripheral surface of the AF/MF switching ring 17, with a plurality of stop grooves 31a which are arranged at equi-angular intervals about the optical axis O. The distance adjustment ring 11 is provided at a front end thereof with a front outer flange 33. The distance 20 adjustment ring 11 is provided with a plurality of engaging grooves 33a, on an outer peripheral surface of the front outer flange 33 that faces an inner peripheral surface of the AF/MF switching ring 17, which are arranged at equi-angular intervals about the optical axis 25 O. As shown in Figures 1 through 3, the rear end of the

outer peripheral surface of the rear outer flange 31 is formed as a rear beveled surface 31b which extends fully around the optical axis O, while the front end of the outer peripheral surface of the front outer flange 33 is formed 5 as a front beveled surface 33b which extends fully around the optical axis O. The rear ends of the plurality of stop grooves 31a are open on the rear beveled surface 31b while the front ends of the plurality of engaging grooves 33a are open on the front beveled surface 33b.

10 The AF/MF switching ring 17 is provided, on an inner peripheral surface thereof in the vicinity of the front end of the AF/MF switching ring 17, with a recess 17d which is elongated in the optical axis direction. The AF/MF switching ring 17 is provided in the recess 17d with a 15 support member 17f which extends between opposite surfaces 17e (only one of them appears in Figures 1 through 3) in the recess 17d in a circumferential direction of the AF/MF switching ring 17. A leaf spring 35 is positioned in the recess 17d, and a central portion of 20 the leaf spring 35 is fixed to the support member 17f by a set screw 37 so that the direction of the length of the leaf spring 35 is parallel to the optical axis O. An AF engaging member (engaging portion) 39 is fixed to a rear end of an inward surface of the leaf spring 35 which faces 25 the distance adjustment ring 11, while an MF engaging

member (engaging portion) 41 is fixed to a front end of the inward surface of the leaf spring 35. The AF engaging member 39 is fixed to the leaf spring 35 so that the position of the AF engaging member 39 corresponds to the 5 position of the rear outer flange 31 in the optical axis direction when the AF/MF switching ring 17 is in the AF position, and the MF engaging member 41 is fixed to the leaf spring 35 so that the position of the MF engaging member 41 corresponds to the position of the front outer 10 flange 33 in the optical axis direction when the AF/MF switching ring 17 is in the MF position. Namely, the AF engaging member 39 is fixed to the leaf spring 35 so that when the AF/MF switching ring 17 is in the AF position and the AF engaging member 39 is aligned with one of the 15 plurality of stop grooves 31a in the circumferential direction, the AF engaging member 39 engages with the stop groove 31a. Likewise, the MF engaging member 41 is fixed to the leaf spring 35 so that when the AF/MF switching ring 17 is in the MF position and, the MF engaging member 20 41 is aligned with one of the plurality of engaging grooves 33a in the circumferential direction, the MF engaging member 41 engages with the engaging groove 33a.

Operations of the lens barrel 1 which has the above described structure will be hereinafter discussed. When 25 the AF/MF switching ring 17 is in the MF position (Figure

1), the AF/MF switching ring 17 is held in the MF position due to the stop ball B being engaged in the front circumferential annular groove 17a. At this time, the gear portion 15b of the gear cylinder 15 and the 5 circumferential gear portion 11c of the distance adjustment ring 11 are disengaged from each other because the engaging portion 29b of the coupling member 29 presses the flange 15c of the gear cylinder 15 rearward which is biased forward by the compression coil spring S. 10 Accordingly, rotation of the rotary shaft 13, which is driven by the AF motor (not shown) provided in the associated camera body, is not transferred to the distance adjustment ring 11 when the AF/MF switching ring 17 is in the MF position. Consequently, an autofocusing 15 operation cannot be performed when the AF/MF switching ring 17 is in the MF position.

In addition, when the AF/MF switching ring 17 is in the MF position, rotating the AF/MF switching ring 17 about the optical axis O causes the distance adjustment 20 ring 11 to rotate about the optical axis O due to engagement of the MF engaging member 41 with one of the plurality of engaging grooves 33a. This rotation of the distance adjustment ring 11 is transferred to the focusing ring 9 via the engagement of the set of drive power 25 ring 9 via the engagement of the set of drive power transfer pins 9b with the set of axial grooves 11b, thus

moving the focusing ring 9 along the optical axis O while rotating the same about the optical axis O. Therefore, a manual focusing operation can be carried out by rotation of the AF/MF switching ring 17 when the AF/MF switching ring 17 is in the MF position.

Operations of the lens barrel 1 when the AF/MF switching ring 17 is moved from the MF position to the AF position will be hereinafter discussed. When the AF/MF switching ring 17 is moved from the MF position to the AF position, the MF engaging member 41 moves forward from the front outer flange 33 to be disengaged from one of the plurality of engaging grooves 33a through the front end opening of the one engaging groove 33a as shown in Figure 2. At the same time, the AF engaging member 39 moves forward to be engaged in one of the plurality of stop grooves 31a through the rear end opening of the one stop groove 31a if the AF engaging member 39 is aligned with one of the stop grooves 31a in the optical axis direction. If the AF engaging member 39 is not aligned with one of the stop grooves 31a, the leaf spring 35 is resiliently deformed so that the AF engaging member 39 runs on the outer peripheral surface of the rear outer flange 31 over the rear beveled surface 31b (see Figure 2). In this state, a slight rotation of the AF/MF switching ring 17 causes the AF engaging member 39 align

with one of the plurality of stop grooves 31a in the circumferential direction, thus causing the AF engaging member 39 to engage in one of the plurality of stop grooves 31a by the resiliency of the leaf spring 35 (see Figure

5 3).

When moved from the MF position to the AF position, the AF/MF switching ring 17 is held in the AF position by the engaging of the stop ball B with the rear circumferential annular groove 17b.

10 Such a movement of the AF/MF switching ring 17 from the MF position to the AF position causes the engaging portion 29b of the coupling member 29 to be disengaged from the flange 15c of the gear cylinder 15. This disengagement of the engaging portion 29b from the flange 15c causes the gear portion 15b of the gear cylinder 15 to be engaged with the gear portion 11c of the distance adjustment ring 11 because the gear cylinder 15 is biased forward by the compression coil spring S. In this state where the gear portion 15b is engaged with the gear portion 11c, rotation of the AF motor (not shown) provided in the associated camera body is transferred to the distance adjustment ring 11 to rotate the distance adjustment ring 11 via the rotary shaft 13 and the gear cylinder 15 upon rotation of the AF motor. This rotation of the distance 20 adjustment ring 11 is transferred to the focusing ring 25

9 via the engagement of the set of drive power transfer pins 9b with the set of axial grooves 11b, thus moving the focusing ring 9 along the optical axis O while rotating the same about the optical axis O to perform an 5 autofocusing operation.

When the AF/MF switching ring 17 is moved from the AF position to the MF position, the AF engaging member 39 moves rearward from the rear outer flange 31 to be disengaged from one of the plurality of stop grooves 31a through the rear end opening of the one stop groove 31a. At the same time, the MF engaging member 41 moves rearward to be engaged in one of the plurality of engaging grooves 33a through the front end opening of the engaging groove 33a if the MF engaging member 41 is aligned with the 10 engaging groove 33a in the optical axis direction. If the MF engaging member 41 is not aligned with the engaging groove 33a, the leaf spring 35 is resiliently deformed so that the MF engaging member 41 runs on the outer 15 peripheral surface of the front outer flange 33 over the front beveled surface 33b. In this state, a slight rotation of the AF/MF switching ring 17 causes the MF engaging member 41 align with one of the plurality of engaging grooves 33a in the circumferential direction, thus causing the MF engaging member 41 to engage in one 20 of the plurality of engaging grooves 33a by the resiliency 25 of the plurality of engaging grooves 33a by the resiliency

of the leaf spring 35.

According to the above described embodiment of the lens barrel 1, the cost of production and the cost of assembly of the lens barrel are less than in the case where 5 the AF engaging member 39 and the MF engaging member 41 are fixed independently to the AF/MF switching ring 17, due to the AF engaging member 39 and the MF engaging member 41, which are respectively engageable in any of the plurality of stop grooves 31a and any of the plurality 10 of engaging grooves 33a, being fixed to the leaf spring 35 by screws (not shown) so as to be integral with the leaf spring 35, and due to this leaf spring 35 being fixed to the AF/MF switching ring 17. In addition, miniaturization of the lens barrel 1 can be achieved.

15 Note that although in the illustrated embodiment the AF engaging member 39 and the MF engaging member 41 are fixed to the leaf spring 35 with screws, it is alternatively possible to form (mold) the AF engaging member 39 and the MF engaging member 41 with the leaf 20 spring 35 as an integrally formed member out of a compound resin.

Moreover, the AF engaging member 39 and the MF engaging member 41 can be easily engaged in any one of the plurality of stop grooves 31a and any one of the 25 plurality of engaging grooves 33a, respectively, by a

slight rotation of the AF/MF switching ring 17 even if
the AF engaging member 39 runs on the outer peripheral
surface of the rear outer flange 31 or the MF engaging
member 41 runs on the outer peripheral surface of the front
5 outer flange 33 when the AF/MF switching ring 17 is moved
from the AF position to the MF position or from the MF
position to the AF position. This is because the AF
engaging member 39 and the MF engaging member 41 are
automatically engaged in one of the plurality of stop
10 grooves 31a and one of the plurality of engaging grooves
33a due to the spring force of the leaf spring 35
immediately after the AF engaging member 39 and the MF
engaging member 41 become aligned with one of the
plurality of stop grooves 31a and one of the plurality
15 of engaging grooves 33a in the circumferential direction,
respectively, when the AF/MF switching ring 17 is rotated.

Furthermore, the AF engaging member 39 and the MF
engaging member 41 can be easily engaged in any one of
the plurality of stop grooves 31a and any one of the
20 plurality of engaging grooves 33a, respectively, by a
slight rotation of the AF/MF switching ring 17 since the
plurality of stop grooves 31a are arranged on the rear
outer flange 31 at equi-angular intervals in a
circumferential direction of the rear outer flange 31
25 while the plurality of engaging grooves 33a are arranged

on the front outer flange 33 at equi-angular intervals in a circumferential direction of the front outer flange 33.

As can be understood from the foregoing, a lens
5 barrel having a switching mechanism between an automatic focusing mode and a manual focusing mode is achieved, wherein the cost of production and the cost of assembly of the lens barrel can be reduced and the lens barrel can be miniaturized.

10 Obvious changes may be made in the specific embodiment of the present invention described herein, such modifications being within the spirit and scope of the invention claimed. It is indicated that all matter contained herein is illustrative and does not limit the
15 scope of the present invention.